

# A New Species of *Nototrichium* (Amaranthaceae) from Kaua'i, Hawaiian Islands

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**ABSTRACT.** *Nototrichium divaricatum* Lorence from the Hawaiian Island of Kaua'i, distinguished from its congeners by its compoundly branched inflorescences with divaricate branches and shorter spikes, is described and illustrated, and its affinities within the genus are discussed.

*Nototrichium* (A. Gray ex Hillebrand) Hillebrand is a Hawaiian endemic genus of shrubs or occasionally small trees restricted to mesic and dry forest and shrubland communities. *Nototrichium* was originally established as a genus by Hillebrand (1888) to encompass three species: *N. sandwicense* Hillebrand (with two additional varieties), *N. humile* Hillebrand, and *N. viride* Hillebrand. Subsequently, Schinz (1931) described an additional species, *N. fulvum* Schinz. In a series of publications Sherff (1950a, b, 1951a, b, 1962) described over 20 varieties of *N. sandwicense*. St. John (1980) later described a new variety of *N. viride*. Many of these taxa were based on variable characters, such as pubescence density, leaf size, and inflorescence shape and length. In the most recent treatment of the genus, Wagner et al. (1990) recognized only two species, *N. humile* and *N. sandwicense*, with no infraspecific categories. The former species is federally listed as endangered and restricted to O'ahu (Wai'anae Mts.) and one locality on East Maui, whereas the latter species is much more common and widespread, occurring on all eight of the main Hawaiian Islands: Kaua'i, Ni'ihau, O'ahu, Moloka'i, Lana'i, Maui, Kaho'olawe, and Hawai'i (Wagner et al., 1990).

*Nototrichium* belongs to subfamily Amaranthoideae based on its bithecal (tetrasporangiate) anthers and pollen of the *Amaranthus*-type (Eliasson, 1988). The following combination of characters distinguishes it from other genera of native and naturalized Amaranthaceae in Hawai'i: shrubby or arborescent habit, densely silky strigose pubescence, opposite leaves, flowers in terminal spikes, flowers and fruit ascending, and flowers 4-merous. *Nototrichium* is clearly related to the primarily Old World genus *Achyranthes* L., which differs by its reflexed flowers and fruit and 5-merous flowers, although

certain anomalous species, such as *A. arborescens* R. Brown from Norfolk Island, have 4-merous flowers (Hillebrand, 1888; Wagner et al., 1990). Nevertheless, the pollen structure of *Nototrichium* closely resembles that of certain species of *Cyathula* Blume (Eliasson, 1988).

An unusual species of *Nototrichium* not corresponding with any of the described taxa was first collected on the Na Pali coast region of northwestern Kaua'i by Steve Montgomery in 1985 and was relocated in 1991 by Kenneth R. Wood, staff member of the National Tropical Botanical Garden. Further exploration of this rugged area by Wood revealed a continuous band of this species comprising an estimated 1000 individuals growing on north-facing cliffs in Kalalau, Pohakuao, and Honopu valleys between ca. 600 and 1100 m elevation. Critical study of the specimens leaves no doubt that they represent a new species of *Nototrichium*.

## ***Nototrichium divaricatum* Lorence, sp. nov.**

**TYPE:** Hawaiian Islands (U.S.A.). Kaua'i: Hanalei District, Kalalau rim, 320° NW-facing cliffs below and E of first Kalalau lookout, diverse montane precipitous slopes with small pockets of forest and vertical cliffs, 1000–1100 m, 15 Sep. 1991, K. R. Wood, M. Query & D. Boynton 1227 (holotype, PTBG; isotypes, BISH, F, MO, NY, US). Figure 1.

Species inflorescentia pluriramosa, ramulis divaricatis, ramulis primariis paribus 1(–2), interdum ramulis secundariis instructis, spicis brevioribus 5–20(–35) mm longis, (4–)8–30(–66) floribus a congeneribus bene distincta.

Densely branching shrubs 0.3–2 m tall, most parts densely sericeous with straight, silvery-white, appressed, simple hairs 0.2–0.6 mm long; twigs densely white-sericeous, terete or slightly quadrangular, 1.5–2.5 mm diam., the internodes (0.5–)1–6.5 cm long; leaves opposite, petiolate, equal; petioles 3–12 × 0.8–1.5 mm, adaxially flattened or concave, narrowly winged distally, densely sericeous; lamina elliptic, narrowly elliptic, lanceolate, rarely rhombic-elliptic or obovate-elliptic, (2–)3–7.5 × (0.6–)1–4.6 cm, chartaceous, adaxially

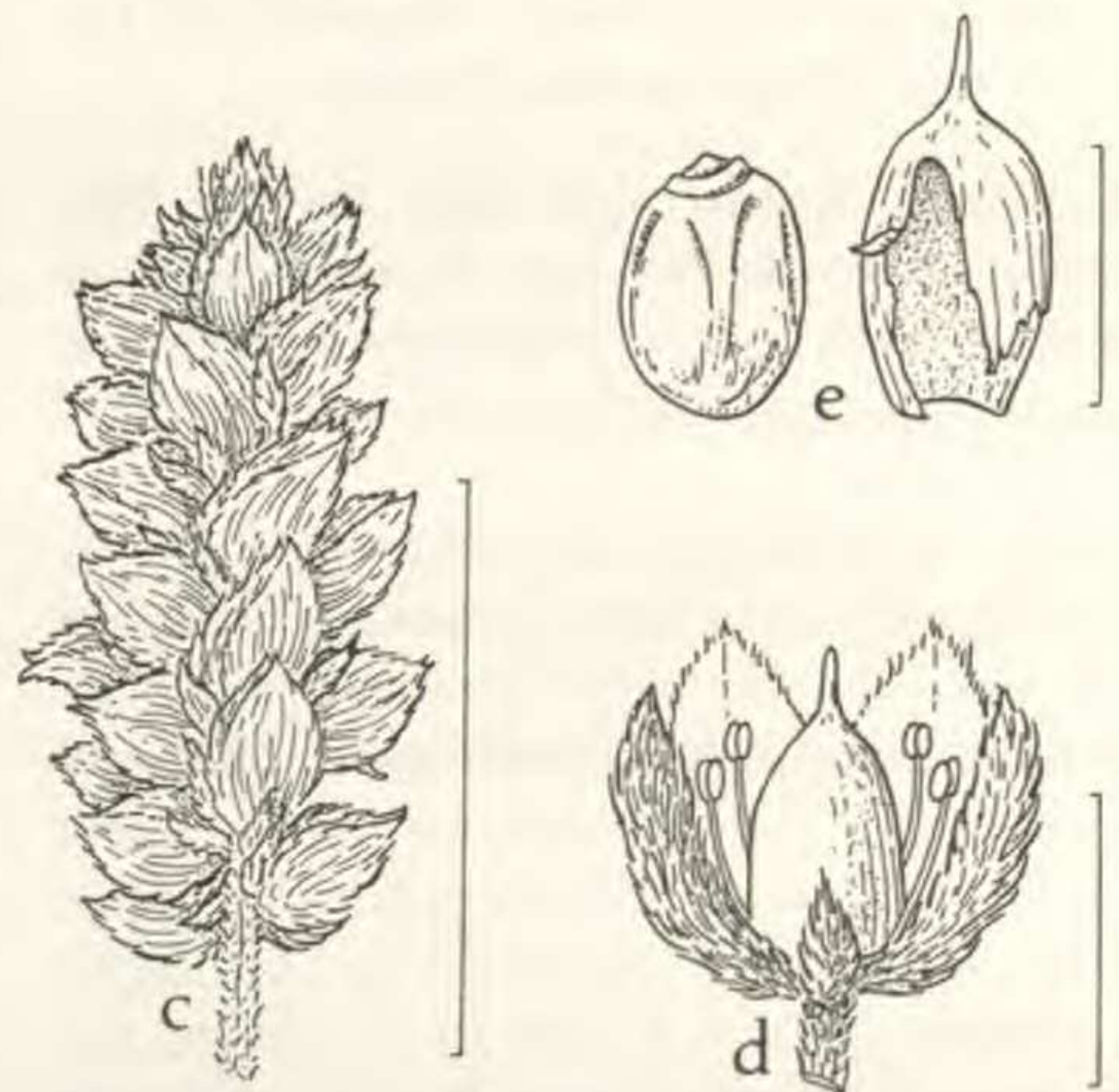
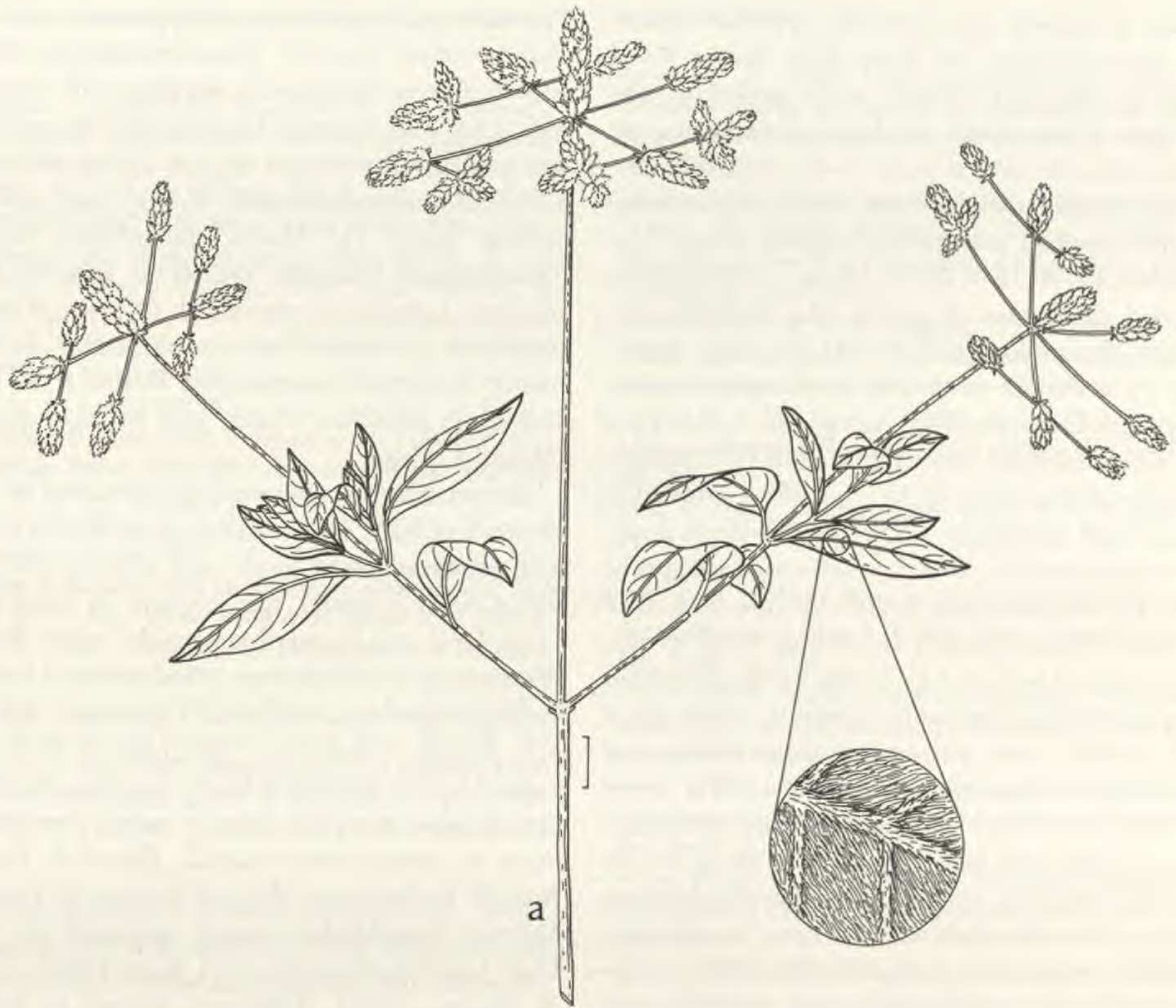


Figure 1. *Nototrichium divaricatum* Lorence. —a. Habit of plant with highly branched inflorescence. —b. Habit of plant with sparsely branched inflorescence. —c. Spike of flowers. —d. Flower, sepals opened. —e. Seed and ruptured fruit wall. a, c, Wood *et al.* 1227; b, Wood 1155, d, Wood *et al.* 1771, e, Wood 1156. Bars = 1 cm in a, b, 1.8 cm in c, 3 mm in d, 1.6 mm in e.

sparsely to densely sericeous with appressed hairs, often white-punctate, the hairs often denser along the costa, abaxially densely white-sericeous, the apex acute or acuminate, the base narrowly cuneate to attenuate, the lateral veins 7–10 on a side, ascending straight then arching near margin. Inflorescence terminal and usually solitary, rarely 2 or 3 together, (3–)4–18 × (2–)3–19 cm, a compoundly branched dichasium of spikes, the branches divaricate, the peduncle 2–8(–11) cm long, terminated by a sessile or shortly pedunculate spike, the primary branches 2–4(–5), radiate, 1.5–5.5 cm long, often unequal, each terminated by a sessile or shortly pedunculate spike, this often subtended by a pair of secondary branches 0.3–2 cm long, each terminated by 1 or 3 sessile spikes; spikes (4–)8–30(–66)-flowered, 5–20(–35) mm long, 5–7 mm diam.; flowers weakly ascending, ovoid to narrowly ovoid, 0.5–3 × 1.8–2 mm, each subtended by an externally sericeous, scarious, ovate bract 1.5–2 × 0.8–1 mm, persistent on the rachis, and 2 externally sericeous, scarious, narrowly ovate bracteoles 1.2–1.8 × 0.8–1 mm long, deciduous with the calyx and fruit; sepals 4, ovate, 2.3–3 × 1–2 mm, concave, externally uniformly white-sericeous, internally glabrous, the apex usually mucronulate; stamens 4, included, the anthers ellipsoid, 0.5 mm long, bilobed at apex and base, the filaments 0.7–0.9 mm long, pilose, connate at base; ovary subglobose-depressed, 0.6–0.8 mm long, white-pilosulous, the persistent style 0.5–0.6 mm long, stigma capitate. Fruit enclosed by the persistent calyx, ellipsoid or obovoid, 2 × 1.4 mm, pilosulous distally, the wall thin, tardily transversely dehiscent; seed broadly ellipsoid, 1.5–1.6 × 1.1–1.2 mm, the testa shiny brown.

*Distribution.* Known only from the Na Pali coast region in the Na Pali-Kona Forest Reserve of northwestern Kaua'i, where it has been collected in Kalalau, Honopu, and Pohakuao valleys at ca. 600–1100 m elevation.

*Habitat.* *Nototrichium divaricatum* occurs on north-facing cliffs and ridges in remnants of diverse lowland and montane mesic forest dominated by *Metrosideros polymorpha* Gaudichaud, *Diospyros sandwicensis* (A. DC.) Fosberg, and *Dicranopteris linearis* (N. L. Burman) Underwood. Other mesic forest associates include: *Acacia koa* A. Gray, *Boehmeria grandis* (Hooker & Arnott) A. Heller, *Coprosma* spp., *Dodonaea viscosa* Jacquin, *Dubautia* spp., *Exocarpus luteolus* C. Forbes, *Fleuggea neowawraea* W. Hayden, *Kokia kauaiensis* (Rock) O. Degener & Duvel, *Lysimachia glutinosa* Rock, *Melicope pallida* (Hillebrand) T. Hartley & B. Stone,

*Peucedanum sandwicense* Hillebrand, and *Pritchardia minor* Beccari. This new species also occurs in diverse dry to mesic shrubby cliff vegetation with *Artemesia australis* Lessing, *Bidens sandwicensis* Lessing, *Chamaesyce* sp. nov., *Eragrostis variabilis* (Gaudichaud) Steudel, *Hedyotis* sp. nov., *Lepidium serra* H. Mann, *Lipochaeta connata* (Gaudichaud) Candolle var. *acris* (Sherff) R. C. Gardner, *Lobelia niihauensis* H. St. John, *Panicum lineale* H. St. John, *Poa mannii* Munro ex Hillebrand, *Stenogyne campanulata* Weller & A. Sakai, *Vaccinium dentatum* Smith, and *Wilkesia gymnoxiphium* A. Gray.

*Nototrichium divaricatum* is restricted to steep slopes and cliffs where remnants of native lowland and montane mesic forest and diverse cliff vegetation have escaped the ravages of feral goats. Large feral goat populations are the major threat to this new species and many other rare and localized endemic species in Kalalau, Pohakuao, and Honopu valleys. Herbivory and habitat destruction caused by the goats will likely result in the extinction of these rare plant species unless measures are taken to control these animals (Wood & Perlman, Rare & Endangered Flora of Kalalau & Pohakuao Valleys. Unpublished report prepared for Sierra Club Legal Defense Fund (1 June 1993); Lorence & Wagner, 1995). Additional threats to this new species are landslides, falling rocks, feral pigs in some areas, and choking invasion by alien plant species, particularly *Erigeron karvinskianus* DC., but also including *Rubus rosifolius* Smith, *Kalanchoë pinnata* (Lamarck) Persoon, *Lantana camara* L., *Melinis minutiflora* Palisot de Beauvois, *Psidium guajava* L., *Setaria gracilis* Kunth, and *Verbena littoralis* Kunth.

*Affinities.* *Nototrichium divaricatum* differs from other members of the genus by its compoundly branched inflorescences with divaricate branches and shorter spikes 5–20(–35) mm long with (4–)8–30(–66) flowers per spike. This new species is most closely related to *N. sandwicensis*, a dry forest species that further differs by its bracts subtending the flowers tipped by a spine 2 mm long and sepals with long, spreading hairs and a large tuft of hairs at the base. Field observations on Kaua'i have revealed that *N. divaricatum* and *N. sandwicensis* are habitat-differentiated and do not grow sympatrically except at a single locality, the Kalahu portion of Kalalau Valley, where the latter species occurs in mesic forest adjacent to cliffs harboring the former species (K. R. Wood, pers. comm., 1994). *Nototrichium humile*, restricted to O'ahu and East Maui, differs from both *N. divaricatum* and *N. sandwicensis* by its longer, more slender spikes 3–14 cm long

and 4 mm or less in diameter (see Wagner et al., 1990: 195 for illustrations).

*Paratypes.* HAWAIIAN ISLANDS (U.S.A.). **Kaua'i:** Hanalei District, Kalalau Valley, Kalalau rim, Kalahu side below and W of first Kalalau lookout, 900–1000 m, 20 Aug. 1991, *Wood 1154* (PTBG), *Wood 1155* (AD, BISH, MU, P, PTBG, SING, US), *Wood 1156* (BISH, MO, PTBG, US); Kalalau rim, N of Kahuama'a Flat, 800 m, 4 July 1991, *Wood & Query 1003* (F, PTBG, US), 1000 m, 28 July 1992, *Wood 2039* (MO, PTBG); Kalalau rim, N below Pu'u o Kila, 950–1150 m, 7 July 1991, *Wood 1044* (AD, BISH, PTBG); Kalalau Valley, base camp in back of valley, 730 m, 10 June 1992, *Wood et al. 1960* (BISH, PTBG, US), 640 m, 10 June 1992, *Perlman et al. 12807* (PTBG, US); Kalalau Valley, helicopter drop on isolated ridge below and W of first lookout, 579–640 m (1900–2100 ft.), 27 Feb. 1994, *Wood & Perlman 3018* (PTBG), *Wood & Perlman 3024* (BISH, MO, NY, PTBG, US); Kalalau Valley, slopes of Kalahu, 300 m E of navy plane crash, 762 m (2500 ft.), 2 Aug. 1994, *Wood & Perlman 3385* (BISH, F, MO, NY, PTBG, US); Kalalau Valley, between lookouts, 1158–1219 m (3800–4000 ft.), 11 July 1985, *Montgomery s.n.* (BISH); Hanalei District, Pohakuao, hanging valley between Kalalau and Hanakoa, below Pu'u Ki, NW aspect, 600 m, 2 Apr. 1992, *Wood et al. 1771* (PTBG); Hanalei District, Honopu rim, 914 m (3000 ft.), 6 Nov. 1993, *Wood 2826* (NY, PTBG, US), 853 m (2800 ft.), *Wood 2835* (PTBG).

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